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The Need for a New Medical Model: A Challenge for Biomedicine

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At a recent conference on psychiatric education, many psychiatrists seemed to be saying to medicine, "Please take us back and we will never again deviate from the 'medical model.' " For, as one critical psychiatrist put it, "Psychiatry has become a hodgepodge of unscientific opinions, assorted philosophies and 'schools of thought,' mixed metaphors, role diffusion, propaganda, and politicking for 'mental health' and other esoteric goals" (*1*). In contrast, the rest of medicine appears neat and tidy. It has a firm base in the biological sciences, enormous technologic resources at its command, and a record of astonishing achievement in elucidating mechanisms of disease and devising new treatments. It would seem that psychiatry would do well to emulate its sister medical disciplines by finally embracing once and for all the medical model of disease.

But I do not accept such a premise. Rather, I contend that all medicine is in crisis and, further, that medicine's crisis derives from the same basic fault as psychiatry's, namely, adherence to a model of disease no longer adequate for the scientific tasks and social responsibilities of either medicine or psychiatry. The importance of how physicians conceptualize disease derives from how such concepts determine what are considered the proper boundaries of professional responsibility and how they influence attitudes toward and behavior with patients. Psychiatry's crisis revolves around the question of whether the categories of human distress with which it is concerned are properly considered "disease" as currently conceptualized and whether exercise of the traditional authority of the physician is appropriate for their helping functions. Medicine's crisis stems from the logical inference that since "disease" is defined in terms of somatic parameters, physicians need not be concerned with psychosocial issues which lie outside medicine's responsibility and authority. At a recent Rockefeller Foundation seminar on the concept of health, one authority urged that medicine "concentrate on the 'real' diseases and not get lost in the psychosociological underbrush. The physician should not be saddled with problems that have arisen from the abdication of the theologian and the philosopher." Another participant called for "a disentanglement of the organic elements of disease from the psychosocial elements of human malfunction," arguing that medicine should deal with the former only (*2*).

The Two Positions

Psychiatrists have responded to their crisis by embracing two ostensibly opposite positions. One would simply exclude psychiatry from the field of medicine, while the other would adhere strictly to the "medical model" and limit psychiatry's field to behavioral disorders consequent to brain dysfunction. The first is exemplified in the writings of Szasz and others who advance the position that "mental illness is a myth" since it does not conform with the accepted concept of disease (*3*). Supporters of this position advocate the removal of the functions now performed by psychiatry from the conceptual and professional jurisdiction of medicine and their reallocation to a new discipline based on behavioral science. Henceforth medicine would be responsible for the treatment and cure of disease, while the new discipline would be concerned with the reeducation of people with "problems of living." Implicit in this argument is the premise that while the medical model constitutes a sound framework within which to understand and treat disease, it is not relevant to the behavioral and psychological problems classically deemed the domain of psychiatry. Disorders directly ascribable to brain disorder would be taken care of by neurologists, while psychiatry as such would disappear as a medical discipline.

The contrasting posture of strict adherence to the medical model is caricatured in Ludwig's view of the psychiatrist as physician (*1*). According to Ludwig, the medical model premises "that sufficient deviation from normal represents *disease*, that disease is due to known or unknown natural causes, and that elimination of these causes will result in cure or improvement in individual patients" (Ludwig's italics). While acknowledging that most psychiatric diagnoses have a lower level of confirmation than most medical diagnoses, he adds that they are not "qualitatively different provided that mental disease is assumed to arise largely from 'natural' rather than metapsychological, interpersonal or societal causes." "Natural" is defined as "biological brain dysfunctions, either biochemical or neurophysiological in nature." On the other hand, "disorders such as problems of living, social adjustment reactions, character disorders, dependency syndromes, existential depressions, and various social deviancy conditions [would] be excluded from the concept of mental illness since these disorders arise in individuals with presumably intact neurophysiological functioning and are produced primarily by psychosocial variables." Such "nonpsychiatric disorders" are not properly the concern of the physician-psychiatrist and are more appropriately handled by nonmedical professionals.

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In sum, psychiatry struggles to clarify its status within the mainstream of medicine, if indeed it belongs in medicine at all. The criterion by which this question is supposed to be resolved rests on the degree to which the field of activity of psychiatry is deemed congruent with the existing medical model of disease. But crucial to this problem is another, that of whether the contemporary model is, in fact, any longer adequate for medicine, much less for psychiatry. For if it is not, then perhaps the crisis of psychiatry is part and parcel of a larger crisis that has its roots in the model itself. Should that be the case, then it would be imprudent for psychiatry prematurely to abandon its models in favor of one that may also be flawed.

The Biomedical Model

The dominant model of disease today is biomedical, with molecular biology its basic scientific discipline. It assumes disease to be fully accounted for by deviations from the norm of measurable biological (somatic) variables. It leaves no room within its framework for the social, psychological, and behavioral dimensions of illness. The biomedical model not only requires that disease be dealt with as an entity independent of social behavior, it also demands that behavioral aberrations be explained on the basis of disordered somatic (biochemical or neurophysiological) processes. Thus the biomedical model embraces both reductionism, the philosophic view that complex phenomena are ultimately derived from a single primary principle, and mind-body dualism, the doctrine that separates the mental from the somatic. Here the reductionistic primary principle is physicalistic; that is, it assumes that the language of chemistry and physics will ultimately suffice to explain biological phenomena. From the reductionist viewpoint, the only conceptual tools available to characterize and experimental tools to study biological systems are physical in nature (*4*).

The biomedical model was devised by medical scientists for the study of disease. As such it was a scientific model; that is, it involved a shared set of assumptions and rules of conduct based on the scientific method and constituted a blueprint for research. Not all models are scientific. Indeed, broadly defined, a model is nothing more than a belief system utilized to explain natural phenomena, to make sense out of what is puzzling or disturbing. The more socially disruptive or individually upsetting the phenomenon, the more pressing the need of humans to devise explanatory systems. Such efforts at explanation constitute devices for social adaptation. Disease par excellence exemplifies a category of natural phenomena urgently demanding explanation (*5*). As Fabrega has pointed out, "disease" in its generic sense is a linguistic term used to refer to a certain class of phenomena that members of all social groups, at all times in the history of man, have been exposed to. "When people of various intellectual and cultural persuasions use terms analogous to 'disease,' they have in mind, among other things, that the phenomena in question involve a person-centered, harmful, and undesirable deviation or discontinuity . . . associated with impairment or discomfort" (*5*). Since the condition is not desired it gives rise to a need for corrective actions. The latter involve beliefs and explanations about disease as well as rules of conduct to rationalize treatment actions. These constitute socially adaptive devices to resolve, for the individual as well as for the society in which the sick person lives, the crises and uncertainties surrounding disease (*6*).

Such culturally derived belief systems about disease also constitute models, but they are not scientific models. These may be referred to as popular or folk models. As efforts at social adaptation, they contrast with scientific models, which are primarily designed to promote scientific investigation. The historical fact we have to face is that in modern Western society biomedicine not only has provided a basis for the scientific study of disease, it has also become our own culturally specific perspective about disease, that is, our folk model. Indeed the biomedical model is now the dominant folk model of disease in the Western world (*5, 6*).

In our culture the attitudes and belief systems of physicians are molded by this model long before they embark on their professional education, which in turn reinforces it without necessarily clarifying how its use for social adaptation contrasts with its use for scientific research. The biomedical model has thus become a cultural imperative, its limitations easily overlooked. In brief, it has now acquired the status of *dogma*. In science, a model is revised or abandoned when it fails to account adequately for all the data. A dogma, on the other hand, requires that discrepant data be forced to fit the model or be excluded. Biomedical dogma requires that all disease, including "mental" disease, be conceptualized in terms of derangement of underlying physical mechanisms. This permits only two alternatives whereby behavior and disease can be reconciled: the *reductionist*, which says that all behavioral phenomena of disease must be conceptualized in terms of physicochemical principles; and the *exclusionist*, which says that whatever is not capable of being so explained must be excluded from the category of disease. The reductionists concede that some disturbances in behavior belong in the spectrum of disease. They categorize these as mental diseases and designate psychiatry as the relevant medical discipline. The exclusionists regard mental illness as a myth and would eliminate psychiatry from medicine. Among physicians and psychiatrists today the reductionists are the true believers, the exclusionists are the apostates, while both condemn as heretics those who dare to question the ultimate truth of the biomedical model and advocate a more useful model.

Historical Origins of the Reductionistic Biomedical Model

In considering the requirements for a more inclusive scientific medical model for the study of disease, an ethnomedical perspective is helpful (*6*). In all societies, ancient and modern, preliterate and literate, the major criteria for identification of disease have always been behavioral, psychological, and social in nature. Classically, the onset of disease is marked by changes in physical appearance that frighten, puzzle, or awe, and by alterations in functioning, in feelings, in performance, in behavior, or in relationships that are experienced or perceived as threatening, harmful, unpleasant, deviant, undesirable, or unwanted. Reported verbally or demonstrated by the sufferer or by a witness, these constitute the primary data upon which are based first-order judgments as to whether or not a person is sick (*7*). To such disturbing behavior and reports all societies typically respond by designating individuals and evolving social institutions whose primary function is to evaluate, interpret, and provide corrective measures (*5, 6*). Medicine as an institution and as a discipline, and physicians as professionals, evolved as one form of response to such social needs. In the course of history, medicine became scientific as physicians and other scientists developed a taxonomy and applied scientific methods to the understanding, treatment, and prevention of disturbances which the public

first had designated as "disease" or "sickness."

Why did the reductionistic, dualistic biomedical model evolve in the West? Rasmussen identifies one source in the concession of established Christian orthodoxy to permit dissection of the human body some five centuries ago (*8*). Such a concession was in keeping with the Christian view of the body as a weak and imperfect vessel for the transfer of the soul from this world to the next. Not surprisingly, the Church's permission to study the human body included a tacit interdiction against corresponding scientific investigation of man's mind and behavior. For in the eyes of the Church these had more to do with religion and the soul and hence properly remained its domain. This compact may be considered largely responsible for the anatomical and structural base upon which scientific Western medicine eventually was to be built. For at the same time, the basic principle of the science of the day, as enunciated by Galileo, Newton, and Descartes, was analytical, meaning that entities to be investigated be resolved into isolable causal chains or units, from which it was assumed that the whole could be understood, both materially and conceptually, by reconstituting the parts. With mind-body dualism firmly established under the imprimatur of the Church, classical science readily fostered the notion of the body as a machine, of disease as the consequence of breakdown of the machine, and of the doctor's task as repair of the machine. Thus, the scientific approach to disease began by focusing in a fractional-analytic way on biological (somatic) processes and ignoring the behavioral and psychosocial. This was so even though in practice many physicians, at least until the beginning of the 20th century, regarded emotions as important for the development and course of disease. Actually, such arbitrary exclusion is an acceptable strategy in scientific research, especially when concepts and methods appropriate for the excluded areas are not yet available. But it becomes counterproductive when such strategy becomes policy and the area originally put aside for practical reasons is permanently excluded, if not forgotten altogether. The greater the success of the narrow approach the more likely is this to happen. The biomedical approach to disease has been successful beyond all expectations, but at a cost. For in serving as guideline and justification for medical care policy, biomedicine has also contributed to a host of problems, which I shall consider later.

Limitations of the Biomedical Model

We are now faced with the necessity and the challenge to broaden the approach to disease to include the psychosocial without sacrificing the enormous advantages of the biomedical approach. On the importance of the latter all agree, the reductionist, the exclusionist, and the heretic. In a recent critique of the exclusionist position, Kety put the contrast between the two in such a way as to help define the issues (*9*). "According to the medical model, a human illness does not become a specific disease all at once and is not equivalent to it. The medical model of an illness is a process that moves from the recognition and palliation of symptoms to the characterization of a specific disease in which the etiology and pathogenesis are known and treatment is rational and specific." Thus taxonomy progresses from symptoms, to clusters of symptoms, to syndromes, and finally to diseases with specific pathogenesis and pathology. This sequence accurately describes the successful application of the scientific method to the elucidation and the classification into discrete entities of disease in its generic sense (*5, 6*). The merit of such an approach needs no argument. What do require scrutiny are the distortions introduced by the reductionistic tendency to regard the specific disease as adequately, if not best, characterized in terms of the smallest isolable component having causal implications, for example, the biochemical; or even more critical, is the contention that the designation "disease" does not apply in the absence of perturbations at the biochemical level.

Kety approacnes this problem by comparing diabetes mellitus and schizophrenia as paradigms of somatic and mental diseases, pointing out the appropriateness of the medical model for both. "Both are symptom clusters or syndromes, one described by somatic and biochemical abnormalities, the other by psychological. Each may have many etiologies and shows a range of intensity from severe and debilitating to latent or borderline. There is also evidence that genetic and environmental influences operate in the development of both." In this description, at least in reductionistic terms, the scientific characterization of diabetes is the more advanced in that it has progressed from the behavioral framework of symptoms to that of biochemical abnormalities. Ultimately, the reductionists assume schizophrenia will achieve a similar degree of resolution. In developing his position, Kety makes clear that he does not regard the genetic factors and biological processes in schizophrenia as are now known to exist (or may be discovered in the future) as the only important influences in its etiology. He insists that equally important is elucidation of "how experiential factors and their interactions with biological vulnerability make possible or prevent the development of schizophrenia." But whether such a caveat will suffice to counteract basic reductionism is far from certain.

The Requirements of a New Medical Model

To explore the requirements of a medical model that would account for the reality of diabetes and schizophrenia as human experiences as well as disease abstractions, let us expand Kety's analogy by making the assumption that a specific biochemical abnormality capable of being influenced pharmacologically exists in schizophrenia as well as in diabetes, certainly a plausible possibility. By obliging ourselves to think of patients with diabetes, a "somatic disease," and with schizophrenia, a "mental disease," in exactly the same terms, we will see more clearly how inclusion of somatic and psychosocial factors is indispensable for both; or more pointedly, how concentration on the biomedical and exclusion of the psychosocial distorts perspectives and even interferes with patient care.

1) In the biomedical model, demonstration of the specific biochemical deviation is generally regarded as a specific diagnostic criterion for the disease. Yet in terms of the human experience of illness, laboratory documentation may only indicate disease potential, not the actuality of the disease at the time. The abnormality may be present, yet the patient not be ill. Thus the presence of the biochemical defect of diabetes or schizophrenia at best defines a necessary but not a sufficient condition for the occurrence of the human experience of the disease, the illness. More accurately, the biochemical defect constitutes but one factor among many, the complex interaction of which ultimately may culminate in active disease or manifest illness (*10*). Nor can the biochemical defect be made to account for all of the illness, for full understanding requires additional concepts and frames of reference. Thus, while the diagnosis of diabetes is first suggested by certain core clinical manifestations, for example, polyuria, poly-

dipsia, polyphagia, and weight loss, and is then confirmed by laboratory documentation of relative insulin deficiency, how these are experienced and how they are reported by any one individual, and how they affect him, all require consideration of psychological, social, and cultural factors, not to mention other concurrent or complicating biological factors. Variability in the clinical expression of diabetes as well as of schizophrenia, and in the individual experience and expression of these illnesses, reflects as much these other elements as it does quantitative variations in the specific biochemical defect.

2) Establishing a relationship between particular biochemical processes and the clinical data of illness requires a scientifically rational approach to behavioral and psychosocial data, for these are the terms in which most clinical phenomena are reported by patients. Without such, the reliability of observations and the validity of correlations will be flawed. It serves little to be able to specify a biochemical defect in schizophrenia if one does not know how to relate this to particular psychological and behavioral expressions of the disorder. The biomedical model gives insufficient heed to this requirement. Instead it encourages bypassing the patient's verbal account by placing greater reliance on technical procedures and laboratory measurements. In actuality the task is appreciably more complex than the biomedical model encourages one to believe. An examination of the correlations between clinical and laboratory data requires not only reliable methods of clinical data collection, specifically high-level interviewing skills, but also basic understanding of the psychological, social, and cultural determinants of how patients communicate symptoms of disease. For example, many verbal expressions derive from bodily experiences early in life, resulting in a significant degree of ambiguity in the language patients use to report symptoms. Hence the same words may serve to express primary psychological as well as bodily disturbances, both of which may coexist and overlap in complex ways. Thus, virtually each of the symptoms classically associated with diabetes may also be expressions of or reactions to psychological distress, just as ketoacidosis and hypoglycemia may induce psychiatric manifestations, including some considered characteristic of schizophrenia. The most essential skills of the physician involve the ability to elicit accurately and then analyze correctly the patient's verbal account of his illness experience. The biomedical model ignores both the rigor required to achieve reliability in the interview process and the necessity to analyze the meaning of the patient's report in psychological, social, and cultural as well as in anatomical, physiological, or biochemical terms (*7*).

3) Diabetes and schizophrenia have in common the fact that conditions of life and living constitute significant variables influencing the time of reported onset of the manifest disease as well as of variations in its course. In both conditions this results from the fact that psychophysiologic responses to life change may interact with existing somatic factors to alter susceptibility and thereby influence the time of onset, the severity, and the course of a disease. Experimental studies in animals amply document the role of early, previous, and current life experience in altering susceptibility to a wide variety of diseases even in the presence of a genetic predisposition (*11*). Cassel's demonstration of higher rates of ill health among populations exposed to incongruity between the demands of the social system in which they are living and working and the culture they bring with them provides another illustration among humans of the role of psychosocial variables in disease causation (*12*).

4) Psychological and social factors are also crucial in determining whether and when patients with the biochemical abnormality of diabetes or of schizophrenia come to view themselves or be viewed by others as sick. Still other factors of a similar nature influence whether or not and when any individual enters a health care system and becomes a patient. Thus, the biochemical defect may determine certain characteristics of the disease, but not necessarily the point in time when the person falls ill or accepts the sick role or the status of a patient.

5) "Rational treatment" (Kety's term) directed only at the biochemical abnormality does not necessarily restore the patient to health even in the face of documented correction or major alleviation of the abnormality. This is no less true for diabetes than it will be for schizophrenia when a biochemical defect is established. Other factors may combine to sustain patienthood even in the face of biochemical recovery. Conspicuously responsible for such discrepancies between correction of biological abnormalities and treatment outcome are psychological and social variables.

6) Even with the application of rational therapies, the behavior of the physician and the relationship between patient and physician powerfully influence therapeutic outcome for better or for worse. These constitute psychological effects which may directly modify the illness experience or indirectly affect underlying biochemical processes, the latter by virtue of interactions between psychophysiological reactions and biochemical processes implicated in the disease (*11*). Thus, insulin requirements of a diabetic patient may fluctuate significantly depending on how the patient perceives his relationship with his doctor. Furthermore, the successful application of rational therapies is limited by the physician's ability to influence and modify the patient's behavior in directions concordant with health needs. Contrary to what the exclusionists would have us believe, the physician's role is, and always has been, very much that of educator and psychotherapist. To know how to induce peace of mind in the patient and enhance his faith in the healing powers of his physician requires psychological knowledge and skills, not merely charisma. These too are outside the biomedical framework.

The Advantages of a Biopsychosocial Model

This list surely is not complete but it should suffice to document that diabetes mellitus and schizophrenia as paradigms of "somatic" and "mental" disorders are entirely analogous and, as Kety argues, are appropriately conceptualized within the framework of a medical model of disease. But the existing biomedical model does not suffice. To provide a basis for understanding the determinants of disease and arriving at rational treatments and patterns of health care, a medical model must also take into account the patient, the social context in which he lives, and the complementary system devised by society to deal with the disruptive effects of illness, that is, the physician role and the health care system. This requires a biopsychosocial model. Its scope is determined by the historic function of the physician to establish whether the person soliciting help is "sick" or "well"; and if sick, why sick and in which ways sick; and then to develop a rational program to treat the illness and restore and maintain health.

The boundaries between health and disease, between well and sick, are far from clear and never will be clear, for they are diffused by cultural, social, and psychological considerations. The traditional biomedical view, that biological indices are the ultimate criteria defining

disease, leads to the present paradox that some people with positive laboratory findings are told that they are in need of treatment when in fact they are feeling quite well, while others feeling sick are assured that they are well, that is, they have no "disease" (*5, 6*). A biopsychosocial model which includes the patient as well as the illness would encompass both circumstances. The doctor's task is to account for the dysphoria and the dysfunction which lead individuals to seek medical help, adopt the sick role, and accept the status of patienthood. He must weight the relative contributions of social and psychological as well as of biological factors implicated in the patient's dysphoria and dysfunction as well as in his decision to accept or not accept patienthood and with it the responsibility to cooperate in his own health care.

By evaluating all the factors contributing to both illness and patienthood, rather than giving primacy to biological factors alone, a biopsychosocial model would make it possible to explain why some individuals experience as "illness" conditions which others regard merely as "problems of living," be they emotional reactions to life circumstances or somatic symptoms. For from the individual's point of view his decision between whether he has a "problem of living" or is "sick" has basically to do with whether or not he accepts the sick role and seeks entry into the health care system, not with what, in fact, is responsible for his distress. Indeed, some people deny the unwelcome reality of illness by dismissing as "a problem of living" symptoms which may in actuality be indicative of a serious organic process. It is the doctor's, not the patient's, responsibility to establish the nature of the problem and to decide whether or not it is best handled in a medical framework. Clearly the dichotomy between "disease" and "problems of living" is by no means a sharp one, either for patient or for doctor.

When Is Grief a Disease?

To enhance our understanding of how it is that "problems of living" are experienced as illness by some and not by others, it might be helpful to consider grief as a paradigm of such a borderline condition. For while grief has never been considered in a medical framework, a significant number of grieving people do consult doctors because of disturbing symptoms, which they do not necessarily relate to grief. Fifteen years ago I addressed this question in a paper entitled "Is grief a disease? A challenge for medical research" (*13*). Its aim too was to raise questions about the adequacy of the biomedical model. A better title might have been, "When is grief a disease?," just as one might ask when schizophrenia or when diabetes is a disease. For while there are some obvious analogies between grief and disease, there are also some important differences. But these very contradictions help to clarify the psychosocial dimensions of the biopsychosocial model.

Grief clearly exemplifies a situation in which psychological factors are primary; no preexisting chemical or physiological defects or agents need be invoked. Yet as with classic diseases, ordinary grief constitutes a discrete syndrome with a relatively predictable symptomatology which includes, incidentally, both bodily and psychological disturbances. It displays the autonomy typical of disease; that is, it runs its course despite the sufferer's efforts or wish to bring it to a close. A consistent etiologic factor can be identified, namely, a significant loss. On the other hand, neither the sufferer nor society has ever dealt with ordinary grief as an illness even though such expressions as "sick with grief" would indicate some connection in people's minds. And while every culture makes provisions for the mourner, these have generally been regarded more as the responsibility of religion than of medicine.

On the face of it, the arguments against including grief in a medical model would seem to be the more persuasive. In the 1961 paper I countered these by comparing grief to a wound. Both are natural responses to environmental trauma, one psychological, the other physical. But even at the time I felt a vague uneasiness that this analogy did not quite make the case. Now 15 years later a better grasp of the cultural origins of disease concepts and medical care systems clarifies the apparent inconsistency. The critical factor underlying man's need to develop folk models of disease, and to develop social adaptations to deal with the individual and group disruptions brought about by disease, has always been the victim's ignorance of what is responsible for his dysphoric or disturbing experience (*5, 6*). Neither grief nor a wound fits fully into that category. In both, the reasons for the pain, suffering, and disability are only too clear. Wounds or fractures incurred in battle or by accident by and large were self-treated or ministered to with folk remedies or by individuals who had acquired certain technical skills in such matters. Surgery developed out of the need for treatment of wounds and injuries and has different historical roots than medicine, which was always closer in origin to magic and religion. Only later in Western history did surgery and medicine merge as healing arts. But even from earliest times there were people who behaved as though grief-stricken, yet seemed not to have suffered any loss; and others who developed what for all the world looked like wounds or fractures, yet had not been subjected to any known trauma. And there were people who suffered losses whose grief deviated in one way or another from what the culture had come to accept as the normal course; and others whose wounds failed to heal or festered or who became ill even though the wound had apparently healed. Then, as now, two elements were crucial in defining the role of patient and physician and hence in determining what should be regarded as disease. For the patient it has been his not knowing why he felt or functioned badly or what to do about it, coupled with the belief or knowledge that the healer or physician did know and could provide relief. For the physician in turn it has been his commitment to his professional role as healer. From these have evolved sets of expectations which are reinforced by the culture, though these are not necessarily the same for patient as for physician.

A biopsychosocial model would take all of these factors into account. It would acknowledge the fundamental fact that the patient comes to the physician because either he does not know what is wrong or, if he does, he feels incapable of helping himself. The psychobiological unity of man requires that the physician accept the responsibility to evaluate whatever problems the patient presents and recommend a course of action, including referral to other helping professions. Hence the physician's basic professional knowledge and skills must span the social, psychological, and biological, for his decisions and actions on the patient's behalf involve all three. Is the patient suffering normal grief or melancholia? Are the fatigue and weakness of the woman who recently lost her husband conversion symptoms, psychophysiological reactions, manifestations of a somatic disorder, or a combination of these? The patient soliciting the aid of a physician must have confidence that the M.D. degree has indeed rendered that physician competent to make such differentiations.

A Challenge for Both Medicine and Psychiatry

The development of a biopsychosocial medical model is posed as a challenge for both medicine and psychiatry. For despite the enormous gains which have accrued from biomedical research, there is a growing uneasiness among the public as well as among physicians, and especially among the younger generation, that health needs are not being met and that biomedical research is not having a sufficient impact in human terms. This is usually ascribed to the all too obvious inadequacies of existing health care delivery systems. But this certainly is not a complete explanation, for many who do have adequate access to health care also complain that physicians are lacking in interest and understanding, are preoccupied with procedures, and are insensitive to the personal problems of patients and their families. Medical institutions are seen as cold and impersonal; the more prestigious they are as centers for biomedical research, the more common such complaints (*14*). Medicine's unrest derives from a growing awareness among many physicians of the contradiction between the excellence of their biomedical background on the one hand and the weakness of their qualifications in certain attributes essential for good patient care on the other (*7*). Many recognize that these cannot be improved by working within the biomedical model alone.

The present upsurge of interest in primary care and family medicine clearly reflects disenchantment among some physicians with an approach to disease that neglects the patient. They are now more ready for a medical model which would take psychosocial issues into account. Even from within academic circles are coming some sharp challenges to biomedical dogmatism (*8, 15*). Thus Holman ascribes directly to biomedical reductionism and to the professional dominance of its adherents over the health care system such undesirable practices as unnecessary hospitalization, overuse of drugs, excessive surgery, and inappropriate utilization of diagnostic tests. He writes, "While reductionism is a powerful tool for understanding, it also creates profound misunderstanding when unwisely applied. Reductionism is particularly harmful when it neglects the impact of nonbiological circumstances upon biologic processes." And, "Some medical outcomes are inadequate not because appropriate technical interventions are lacking but because our conceptual thinking is inadequate" (*15*). How ironic it would be were psychiatry to insist on subscribing to a medical model which some leaders in medicine already are beginning to question.

Psychiatrists, unconsciously committed to the biomedical model and split into the warring camps of reductionists and exclusionists, are today so preoccupied with their own professional identity and status in relation to medicine that many are failing to appreciate that psychiatry now is the only clinical discipline within medicine concerned primarily with the study of man and the human condition. While the behavioral sciences have made some limited incursions into medical school teaching programs, it is mainly upon psychiatrists, and to a lesser extent clinical psychologists, that the responsibility falls to develop approaches to the understanding of health and disease and patient care not readily accomplished within the more narrow framework and with the specialized techniques of traditional biomedicine. Indeed, the fact is that the major formulations of more integrated and holistic concepts of health and disease proposed in the past 30 years have come not from within the biomedical establishment but from physicians who have drawn upon concepts and methods which originated within psychiatry, notably the psychodynamic approach of Sigmund Freud and psychoanalysis and the reaction-to-life-stress approach of Adolf Meyer and psychobiology (*16*). Actually, one of the more lasting contributions of both Freud and Meyer has been to provide frames of reference whereby psychological processes could be included in a concept of disease. Psychosomatic medicine—the term itself a vestige of dualism—became the medium whereby the gap between the two parallel but independent ideologies of medicine, the biological and the psychosocial, was to be bridged. Its progress has been slow and halting, not only because of the extreme complexities intrinsic to the field itself, but also because of unremitting pressures, from within as well as from without, to conform to scientific methodologies basically mechanistic and reductionistic in conception and inappropriate for many of the problems under study. Nonetheless, by now a sizable body of knowledge, based on clinical and experimental studies of man and animals has accumulated. Most, however, remains unknown to the general medical public and to the biomedical community and is largely ignored in the education of physicians. The recent solemn pronouncement by an eminent biomedical leader (*2*) that "the emotional content of organic medicine [has been] exaggerated" and "psychosomatic medicine is on the way out" can only be ascribed to the blinding effects of dogmatism.

The fact is that medical schools have constituted unreceptive if not hostile environments for those interested in psychosomatic research and teaching, and medical journals have all too often followed a double standard in accepting papers dealing with psychosomatic relationships (*17*). Further, much of the work documenting experimentally in animals the significance of life circumstances or change in altering susceptibility to disease has been done by experimental psychologists and appears in psychology journals rarely read by physicians or basic biomedical scientists (*11*).

General Systems Theory Perspective

The struggle to reconcile the psychosocial and the biological in medicine has had its parallel in biology, also dominated by the reductionistic approach of molecular biology. Among biologists too have emerged advocates of the need to develop holistic as well as reductionistic explanations of life processes, to answer the "why?" and the "what for?" as well as the "how?" (*18, 19*). Von Bertalanffy, arguing the need for a more fundamental reorientation in scientific perspectives in order to open the way to holistic approaches more amenable to scientific inquiry and conceptualization, developed general systems theory (*20*). This approach, by treating sets of related events collectively as systems manifesting functions and properties on the specific level of the whole, has made possible recognition of isomorphies across different levels of organization, as molecules, cells, organs, the organism, the person, the family, the society, or the biosphere. From such isomorphies can be developed fundamental laws and principles that operate commonly at all levels of organization, as compared to those which are unique for each. Since systems theory holds that all levels of organization are linked to each other in a hierarchical relationship so that change in one affects change in the others, its adoption as a scientific approach should do much to mitigate the holist-reductionist dichotomy and improve communication across scientific disciplines. For medicine, systems theory provides a conceptual approach suitable not only for the proposed biopsychosocial concept of disease but also for studying disease and medical care as interrelated processes (*10, 21*). If

and when a general-systems approach becomes part of the basic scientific and philosophic education of future physicians and medical scientists, a greater readiness to encompass a biopsychosocial perspective of disease may be anticipated.

Biomedicine as Science and as Dogma

In the meantime, what is being and can be done to neutralize the dogmatism of biomedicine and all the undesirable social and scientific consequences that flow therefrom? How can a proper balance be established between the fractional-analytic and the natural history approaches, both so integral for the work of the physician and the medical scientist (*22*)? How can the clinician be helped to understand the extent to which his scientific approach to patients represents a distinctly "human science," one in which "reliance is on the integrative powers of the observer of a complex nonreplicable event and on the experiments that are provided by history and by animals living in particular ecological settings," as Margaret Mead puts it (*23*)? The history of the rise and fall of scientific dogmas throughout history may give some clues. Certainly mere emergence of new findings and theories rarely suffices to overthrow well-entrenched dogmas. The power of vested interests, social, political, and economic, are formidable deterrents to any effective assault on biomedical dogmatism. The delivery of health care is a major industry, considering that more than 8 percent of our national economic product is devoted to health (*2*). The enormous existing and planned investment in diagnostic and therapeutic technology alone strongly favors approaches to clinical study and care of patients that emphasize the impersonal and the mechanical (*24*). For example, from 1967 to 1972 there was an increase of 33 percent in the number of laboratory tests conducted per hospital admission (*25*). Planning for systems of medical care and their financing is excessively influenced by the availability and promise of technology, the application and effectiveness of which are often used as the criteria by which decisions are made as to what constitutes illness and who qualifies for medical care. The frustration of those who find what they believe to be their legitimate health needs inadequately met by too technologically oriented physicians is generally misinterpreted by the biomedical establishment as indicating "unrealistic expectations" on the part of the public rather than being recognized as reflecting a genuine discrepancy between illness as actually experienced by the patient and as it is conceptualized in the biomedical mode (*26*). The professionalization of biomedicine constitutes still another formidable barrier (*8, 15*). Professionalization has engendered a caste system among health care personnel and a peck order concerning what constitute appropriate areas for medical concern and care, with the most esoteric disorders at the top of the list. Professional dominance "has perpetuated prevailing practices, deflected criticisms, and insulated the profession from alternate views and social relations that would illuminate and improve health care" (*15*, p. 21). Holman argues, not unconvincingly, that "the Medical establishment is not primarily engaged in the disinterested pursuit of knowledge and the translation of that knowledge into medical practice; rather in significant part it is engaged in special interest advocacy, pursuing and preserving social power" (*15*, p. 11).

Under such conditions it is difficult to see how reforms can be brought about. Certainly contributing another critical essay is hardly likely to bring about any major changes in attitude. The problem is hardly new, for the first efforts to introduce a more holistic approach into the undergraduate medical curriculum actually date back to Adolph Meyer's program at Johns Hopkins, which was initiated before 1920 (*27*). At Rochester, a program directed to medical students and to physicians during and after their residency training, and designed to inculcate psychosocial knowledge and skills appropriate for their future work as clinicians or teachers, has been in existence for 30 years (*28*). While difficult to measure outcome objectively, its impact, as indicated by a questionnaire on how students and graduates view the issues involved in illness and patient care, appears to have been appreciable (*29*). In other schools, especially in the immediate post–World War II period, similar efforts were launched, and while some flourished briefly, most soon faded away under the competition of more glamorous and acceptable biomedical careers. Today, within many medical schools there is again a revival of interest among some faculty, but they are few in number and lack the influence, prestige, power, and access to funding from peer review groups that goes with conformity to the prevailing biomedical structure.

Yet today, interest among students and young physicians is high, and where learning opportunities exist they quickly overwhelm the available meager resources. It would appear that given the opportunity, the younger generation is very ready to accept the importance of learning more about the psychosocial dimensions of illness and health care and the need for such education to be soundly based on scientific principles. Once exposed to such an approach, most recognize how ephemeral and insubstantial are appeals to humanism and compassion when not based on rational principles. They reject as simplistic the notion that in past generations doctors understood their patients better, a myth that has persisted for centuries (*30*). Clearly, the gap to be closed is between teachers ready to teach and students eager to learn. But nothing will change unless or until those who control resources have the wisdom to venture off the beaten path of exclusive reliance on biomedicine as the only approach to health care. The proposed biopsychosocial model provides a blueprint for research, a framework for teaching, and a design for action in the real world of health care. Whether it is useful or not remains to be seen. But the answer will not be forthcoming if conditions are not provided to do so. In a free society, outcome will depend upon those who have the courage to try new paths and the wisdom to provide the necessary support.

Summary

The dominant model of disease today is biomedical, and it leaves no room within its framework for the social, psychological, and behavioral dimensions of illness. A biopsychosocial model is proposed that provides a blueprint for research, a framework for teaching, and a design for action in the real world of health care.

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Second Phases in Steel

New analytical methods can identify the types and amounts of complex precipitates in steel.

W. R. Bandi

For many years better analytical methods for the determination of second phases in steel have been needed, because these phases are often more closely related to the heat treatment and mechanical properties of the steel than the elemental composition. I discuss here some of the recent approaches to solving this problem.

Ever since steel was first manufactured, metallurgists have been searching for methods of changing its mechanical properties so that specific grades can be made for particular applications. Often such changes are brought about by the addition of one or more alloying elements to the steel, and at least 35 elements have been added for this purpose. Most of these elements can be present in solid solution in iron, but they often change the mechanical properties of the steel by combining with oxygen, nitrogen, carbon, or sulfur to form precipitates in the steel that are referred to as second-phase compounds. Sometimes the second phase will contain two metals such as nickel and titanium combining to form Ni_3Ti, but most often the second phases are oxides, nitrides, carbides, sulfides, carbonitrides, carbosulfides, and similar compounds. These compounds may be formed in the molten bath, during solidification, during rolling or forming, during heat treatment, and sometimes even during storage at ambient temperature.

Table 1 shows how precipitates can affect some of the mechanical and physical properties of steel. Only a portion of the approximately 200 precipitates found in low-alloy, high-alloy, and specialty steels and some of the important mechanical properties are listed. Often metallurgists can associate precipitates with additional changes in the mechanical, physical, and chemical properties of steel. No attempt has been made in Table 1 to note whether a particular precipitate has a detrimental or beneficial effect on the mechanical properties of steel because in many instances the effect can be either positive or negative depending on the amount, size, and distribution of the precipitate. Precipitate concentration can vary from as much as 10 percent (by weight) (cementite, Fe_3C) to as little as 0.002 percent [boron nitride (BN) and ferrous sulfide (FeS)].

The determination of where a precipitate is located in the iron matrix is of great importance in terms of what effect it can have on the properties of the steel. Even very small quantities of a precipitate located at a grain boundary can induce cracking or corrosion, whereas a larger amount of the same material located randomly throughout the steel will not have the same effect. Small particles of carbide or nitride arranged in rows will form a barrier to slip and dislocation movement in the crystals of the iron matrix and are therefore much more effective in conferring strength than randomly arranged particles.

The particle size of the precipitated phase is also important. As an example, the strength of a steel is changed more by particles of carbide and nitride that are 30 to 400 angstroms in size than by larger particles because these smaller particles are much more effective in preventing grain growth, and fine-grained steels are stronger. Frequently very large particles of carbide or nitride are detrimental to the steel, whereas small particles of the same compound can be beneficial.

The magnitude of the analytical chemical problem can be appreciated when one realizes that more than 50 nitrogen compounds can be present in simple and complex steels. These include simple nitrides such as titanium nitride (TiN) or more complex nitrides such as niobium carbonitride (NbC_xN_y), manganese silicon nitride [$(MnSi)N_2$], and aluminum oxynitride (AlO_xN_y). A like number of carbides and oxides and a smaller number of sulfides and carbosulfides may also be found in steels. There are thus several hundred compounds that can exist in the carbon, alloy, and specialty steels presently being produced in the United States. As a result, the identification and determination of second-phase compounds in steel have been a real challenge in the development of improved steels.

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